

CAUDA EQUINA COMPRESSION SYNDROME WITH HERNIATED NUCLEUS PULPOSUS

A REPORT OF EIGHT CASES

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MUCH HAS BEEN WRITTEN on the subject of herniation of the nucleus pulposus in its more common form but little has been described concerning the clinical manifestations of extensive protrusions. We have had occasion, recently, to observe a number of instances of this type in which the protrusions were so extensive as to produce complete, or nearly complete, subarachnoid block with cauda equina compression. The resultant anamnesis so closely simulates cauda equina tumors that most of the early cases were explored for suspected neoplasms, and it was not until the condition had been encountered on several occasions that the possibility of herniated nucleus pulposus could be anticipated. In our experience, indeed, cauda equina compression occurs much more frequently due to herniated nucleus pulposus than to tumor. For this reason, this series of cases is reviewed to evaluate the presenting clinical manifestations, means of diagnosis, operative findings, and the sequelae encountered. These patients have all been observed and treated at the Strong Memorial and Rochester Municipal Hospitals during the past 18 months.

CASE REPORTS

Case 1.—F. S., S. M. H. No. 199505: The patient was a 28-year-old housewife who, 15 months prior to admission, following a normal pregnancy and delivery, developed low back pain on the left side. She was treated for "scoliosis" with a plaster jacket which she wore for three months. The pain disappeared almost entirely until three days prior to admission when, while stooping over, she felt her back "snap." There was immediate pain in the back and down the legs, which increased in severity until admission. The day before entry, numbness of the right leg, left leg, left foot, back of left thigh, vulva, and perineum developed in that order. There was some twitching of the muscles of the buttocks. For 24 hours the patient had been unable to void spontaneously, being incontinent of small amounts of urine occasionally. There had been no bowel movements for two days. The patient was bedridden because of the pain. The past history was negative except for rheumatic fever at age 22.

Physical Examination: This revealed a moderately obese, bedridden young woman in some pain. The general physical and neurologic examinations were not remarkable except for the following positive findings: There was a coarse nystagmus on extremes of lateral gaze. The bladder was palpable nearly to the umbilicus. There was tenderness over the fifth lumbar spine. There was no abnormal alignment of the spine with the patient recumbent, and it was not possible to have her stand. There was a marked weakness of both legs varying from minimal changes in the upper leg muscles to almost

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complete paralysis of the anterior tibial group on the left side. Anesthesia was present in the saddle area, dorsum of both feet, toes, and the sole of the right foot. Hypesthesia was present over the left sole and lateral and posterior aspects of the left leg. Position sense was impaired on the left. Both ankle jerks were absent, but the knee jerks were equal and brisk.

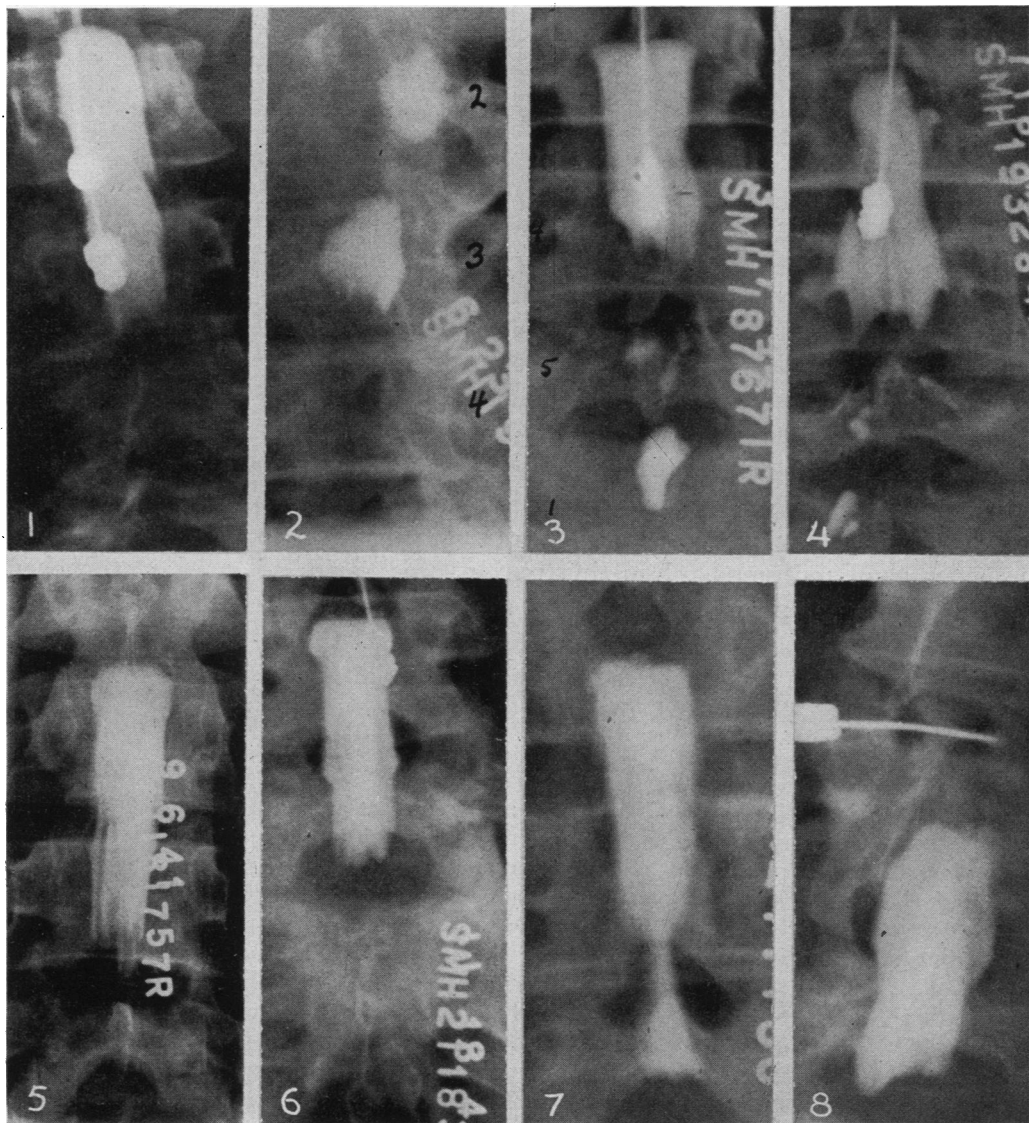


PLATE I.—The myelograms of all patients are shown here. All except Case 2 were made with panto-paque. All were taken with the patient on the fluoroscope table in a nearly erect position.

Laboratory Data: Red blood count of 4.7 million, hemoglobin of 15 Gm.; white blood count of 13,500, with a normal differential. The serology was negative. The urine contained 3-5 white cells per high power field, and *Escherichia coli* was cultured. Lumbar puncture between the third and fourth lumbar vertebrae demonstrated normal manometrics. The fluid showed a negative serology, and a protein content of 110 mg. per cent.

Roentgenograms of the lumbar spine showed narrowing of the fourth lumbar body, and the third, fourth, and fifth lumbar interspaces on the left. Pantopaque myelography demonstrated a complete subarachnoid block at the third lumbar interspace (PLATE I, Fig. 1).

The patient was given sulfadiazine orally and placed on Monroe catheter drainage. On the 18th hospital day, a laminectomy was performed exposing the third lumbar interspace but no defect was seen. The dura was opened, revealing extensive arachnoid thickening with gross matting of the nerve roots of the cauda equina. Exploration with a catheter revealed an obstruction at the fourth interspace, which was subsequently explored, and a large herniated nucleus pulposus removed. The obstruction at L-3 by myelography was felt to be due to the arachnoid adhesions seen on opening the dura.

Postoperatively, the patient was free of pain. She gradually regained control of her bladder and was able to void spontaneously 15 days after operation. When last seen, eight months after operation, she had a mild residual vulvar anesthesia, but normal sphincter control. She was able to walk with the aid of a cane, there being some residual foot drop on the left.

Case 2.—M. D., S. M. H. No. 192500: The patient was a 62-year-old railroad worker who, except for 40-pound weight loss during the preceding two years, was in excellent health until three weeks prior to admission, at which time he awoke with a severe pain in his back radiating down the left leg. This pain persisted and was followed by weakness. Ten days prior to admission, numbness of the lateral aspect of the left leg was noted, and five days later, he was unable to walk because of the weakness and pain. For about a week before entry, there was some nocturia. The pain was aggravated by coughing. Twitching of the muscles of the legs and arms was reported for approximately two months. He had progressive difficulty in voiding but was still continent at the time of operation.

Physical Examination.—This revealed a well-developed elderly man showing some evidence of weight loss. General and neurologic examinations were not remarkable except for the following positive findings: The rectal sphincter was moderately relaxed. There was bilateral weakness of all muscle groups of the legs, more pronounced on the right side and in the peroneal regions. Occasional localized twitchings were seen in the upper and lower extremities. There was sensory loss as high as the first lumbar dermatome on the right and the third lumbar dermatome on the left. Little change was noted in the sensation of the legs but the patient was not able to cooperate well enough for a very exact sensory examination. There was bilateral loss of position and vibratory sense. The left knee jerk was diminished. The right knee jerk and both ankle jerks were absent.

Laboratory Data: Blood studies were normal except for a blood sugar of 200 mg. per cent. Uranalysis revealed a glycosuria. Serology was negative. Lumbar puncture at the fourth lumbar interspace showed a complete block, with xanthochromic fluid having a protein content of 630 mg. per cent. Roentgenograms of the lumbar spine demonstrated a list, with convexity to the right, narrowing of the second lumbar intervertebral space, and hypertrophic changes.

Lipiodol was introduced by cisternal puncture. A complete block was visualized at the third lumbar intervertebral space (PLATE I, Fig. 2). The protein content of the cerebrospinal fluid withdrawn at this time was 25 mg. per cent.

The diabetes was controlled with 20 units of protamine-zinc and 10 units of regular insulin daily. On the tenth hospital day, the patient's spinal canal was explored for tumor of the cauda equina. The third and fourth lumbar laminae were removed, exposing a large herniated nucleus pulposus, which was apparent even on the dorsal surface of the dura (Fig. 1). This was removed (PLATE II, Fig. 1) and the dura opened, revealing matting and injection of the roots of the cauda equina together with a thickened milky-appearing arachnoid. A spinal fusion was carried out.

The postoperative course was complicated by some fecal incontinence, but motor power returned gradually. Bladder and bowel function were normal one to two months after operation. Seventeen months after operation, the patient was asymptomatic, and employed as a laborer. Both ankle jerks were diminished but there was no localized weakness or sensory abnormality.

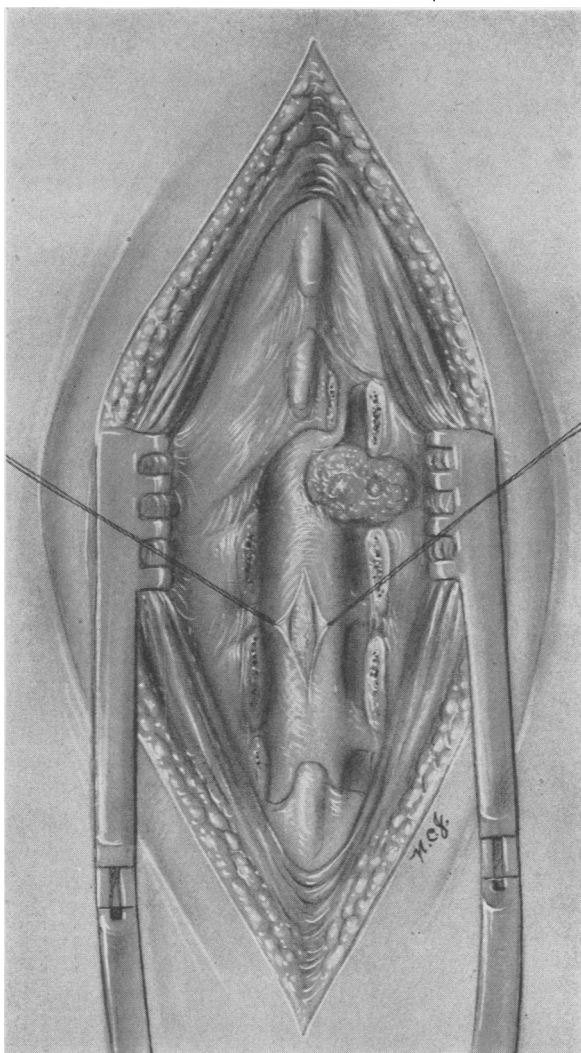


FIG. 1.—A diagrammatic representation of the pathology encountered in Case 2. A cauda equina tumor was anticipated, which accounts for the wide exposure. The extent of the protrusion of the nucleus pulposus is demonstrated at the third lumbar interspace.

Case 3.—A. T., S. M. H. No. 187681: The patient was a 37-year-old cabinetmaker who, for 15 years, had had "lumbago," characterized by low back pain of an intermittent nature coming every three to four months and lasting two or three days at a time. Six months prior to admission, the back pain became more severe, radiating down the back of both legs (the left more than the right). Pain progressed until two

months before admission, when it was knife-like in nature. It was aggravated by coughing and sneezing. No relief was obtained from chiropractic treatments or arch supports. Some frequency of urination and a sensation of fullness of the bladder was noted during this period, as was increasing constipation. Past history was remarkable only in that patient was reported to have had "tuberculosis of the hip" at the age of seven.

Physical Examination.—This revealed the following positive findings: The patient was a muscular man who appeared to be in considerable pain. Movements of the back were limited in all directions although there was no definite list. Straight leg-raising was limited to 30° on the right and 20° on the left. There was measurable atrophy of the left thigh and calf. The Lasègue's sign was positive bilaterally. There was a patchy hypesthesia of both legs, constantly found in the L-4 distribution on the right but noted at times as high as D-12 on the left and L-1 on the right.

Laboratory Data: Blood studies and uranalysis were normal. The Wassermann was negative. Lumbar puncture between third and fourth lumbar vertebrae showed no evidence of block. The fluid showed a total protein content of 100 mg. per cent. The spinal fluid Wassermann was negative.

Myelography with pantopaque showed a block at the midportion of the fourth lumbar vertebrae. A small amount of the contrast material trickled by on the right side. (PLATE I, Fig. 3).

Laminectomy was performed, and a large herniated nucleus pulposus removed from the region of the fourth lumbar interspace (PLATE II, Fig. 2).

The postoperative course was uneventful. Four months after operation the patient was asymptomatic except for mild "lameness" in the back, and was working regularly.

Case 4.—A. B., S. M. H. No. 193284: The patient was a 56-year-old latemaker, who was in excellent health until four months before admission, when he began to have severe pain in the back which would occasionally radiate down both legs. The pain increased in severity until he was forced to stop work seven weeks before admission. At this time he noticed weakness of the left leg associated with diffuse numbness on that side. Shortly before admission, the patient became bedridden by the pain. The pain was greatly aggravated by coughing and straining, by lying flat in bed, and by walking. His only treatment had been "hip-shots" and massage, from which he had no relief. For about five weeks before admission he noticed increasing difficulty in voiding, and a change in bowel habits. The past history was not remarkable.

Physical Examination: This revealed a muscular, elderly-appearing man in apparent pain. The positive findings noted were as follows: The prostate gland was slightly enlarged. There was bilateral lumbar muscle spasm without abnormal alignment of the spine. There was tenderness over sacrum and gluteal regions, somewhat more prominent on the right side. Pain was expressed on all movements of the back and on extension of the legs at the hips. The patient walked with a limp, necessitating the use of a cane. Straight leg-raising was permitted to 75° on the right and 90° on the left. There was hypesthesia over the lateral aspect of the left leg as low as the knee and over a small patch on the lateral aspect of the right knee. Patchy hypesthesia was reported as high as D-10 bilaterally. There was 1 cm. atrophy of the left leg as compared to the right. The left knee and ankle jerk were hypoaactive.

Laboratory Data: The blood count, uranalysis, and blood chemistry were normal, and the Wassermann was negative. Lumbar puncture was attempted at the fourth lumbar interspace without success. Roentgenograms of the lumbar spine showed minor degenerative changes.

Myelography with pantopaque was carried out, revealing an almost complete block at the level of the fourth lumbar intervertebral space. A small amount of the contrast material trickled by the obstruction, as shown in PLATE I, Fig. 4.

Laminectomy was carried out, and a large midline herniated nucleus pulposus removed from the fourth lumbar intervertebral space transdurally (PLATE II, Fig. 3).

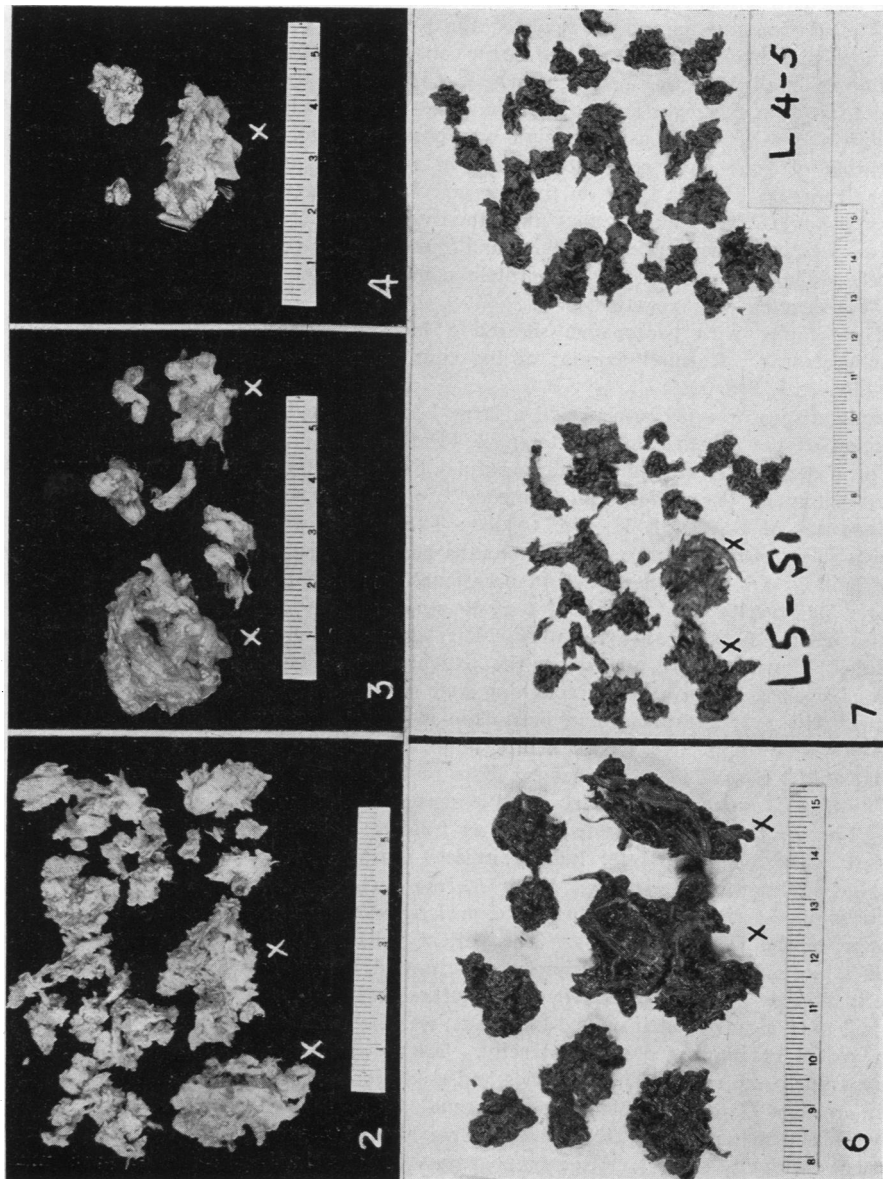


PLATE II.—The material removed at operation in Cases 2, 3, 4, 6 and 7 is shown here. The larger pieces of the tissue marked X represent that portion of the nucleus pulposus extruded into the spinal canal causing the compression. The material removed from each of two interspaces is shown in Case 7.

Postoperative course was uneventful, and the patient was asymptomatic three months after operation.

Case 5.—J. G., S. M. H. No. 181757: The patient was a 45-year-old exmechanic who, for 30 years, had had occasional shooting "numb sensations" down the left leg, noticed mainly after overexertion. For the past ten years, he had had five such episodes lasting approximately three days each. Two weeks before admission, coincident with a "cold" and cough, he developed severe low back pain. Two days later, the pain began to radiate down the left leg, then down the lateral aspect of the right leg, with associated numbness of both legs. He was confined to bed by the pain for two days prior to admission, and had great difficulty in urinating. The pain was sharp and shooting in character and aggravated by cough. It was not relieved by vitamin B injections, morphine, or bed rest.

Physical Examination.—This revealed a well-developed, well-nourished man, who appeared to be in some pain. General and neurologic examinations showed the following positive findings: The teeth were somewhat carious. There were a few coarse dry râles at both lung bases posteriorly. The patient was unable to walk. The spine was straight, with slight tenderness over the sacrum and right lumbar regions. There was bilateral tenderness in the posterior thigh regions. Straight leg-raising was markedly limited because of pain. Twitching was noticed in the glutei and calf muscles. The left thigh and calf were measurably smaller in circumference than the right. There was hypesthesia over both feet, the dorsum of the right calf, lateral aspect of the left calf, and of the saddle area. Vibratory sense was absent on the left. The right knee jerk was diminished and both ankle jerks were absent.

Laboratory Data: The blood count, uranalysis, and stool examinations were within normal limits. The Wassermann was negative. Lumbar puncture between the third and fourth lumbar vertebrae demonstrated normal dynamics, with a spinal fluid protein of 60 mg. per cent.

A chest film was not remarkable. Lumbar spine films showed some deviation to the left. Myelography with pantopaque showed a sharp cut-off in the subarachnoid space at the fourth lumbar interspace (PLATE I, Fig. 5).

Laminectomy was performed and a large herniated nucleus pulposus was removed extra- and transdurally. There was evidence of arachnoiditis on exploring the cauda equina, and microscopic section of the arachnoid showed round cell infiltration.

The postoperative course was uncomplicated. At the time of discharge the patient was asymptomatic. The only positive findings on physical examination were hypesthesia of the left foot and absent ankle jerks bilaterally. He did not return for follow-up.

Case 6.—E. J., S. M. H. No. 311831: The patient was a 28-year-old housewife, who first noticed pain in her right leg approximately ten years before admission, three months following an automobile accident in which she sustained no known injury. This episode lasted one and one-half years. She had similar but shorter attacks six and five years before admission, and following the latter she had operations upon both of her hip regions (probably fasciotomies). Subsequently she complained of repeated episodes of right hip and leg pain, on two occasions relieved by injections in her back. The last episode started approximately six months before admission, following which mild burning pain in the entire right leg on exertion was experienced. She also complained of an occasional twinge of pain in the left leg. Approximately one to two weeks prior to admission the patient noticed more severe pain in both legs associated with paresthesias and numbness in the right leg. Three days before admission, she became unable to void.

Physical Examination.—This revealed the following positive findings: On examination of the back, there was a list to the right, and considerable spasm of the paraspinal muscles. She experienced considerable pain on all movements of the back. Straight leg-raising was limited to 20° on the right and 30° on the left. There was 1 cm. atrophy of the right calf, associated with considerable weakness of all movements of

the foot, particularly with reference to plantar flexion. Mild atrophy was also noted in the left gluteal region and upper leg. Bilateral upper lateral femoral operative scars were present and there was an area of hypesthesia over the distribution of the left lateral femoral cutaneous nerve, which the patient stated had been present since her operation five years before. Hypesthesia was noted bilaterally in segments S-4 and S-5 and on the right in segments L-5 to S-3. Almost complete anesthesia was present over the outer aspect of the right foot. The right knee jerk was diminished and the right ankle jerk absent. The patient was unable to void and had to be placed on tidal irrigation.

Laboratory Data: Blood studies and uranalysis were normal. The serology was

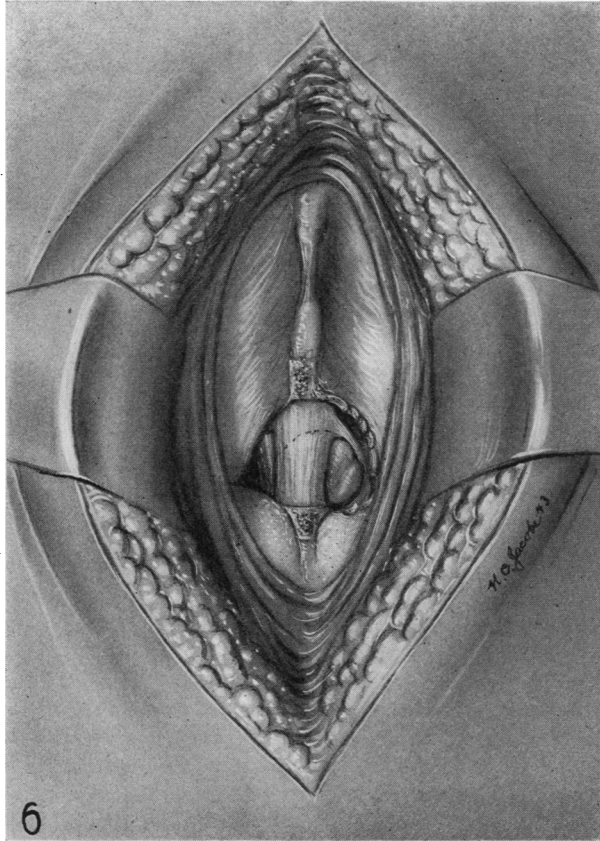


FIG. 2.—A diagrammatic representation of the pathology encountered in Case 6. The extruded nucleus pulposus is seen in the region of the fifth lumbar interspace.

negative. Roentgenograms of the spine showed narrowing of the fifth lumbar interspace. Spinal fluid protein was 90 mg. per cent. A pantopaque myelogram demonstrated a complete block at the fifth lumbar interspace (PLATE I, Fig. 6).

Laminectomy was performed (Fig. 2), and a large herniated nucleus pulposus removed from the fifth lumbar interspace (PLATE II, Fig. 4).

The postoperative course was uneventful. The patient was able to void spontaneously nine days after operation. When last seen, two months after operation, she was free of all discomfort and voiding normally. There was still slight weakness of the right plantar flexors. The right ankle jerk was absent, and there was hypesthesia over the outer aspect of the right leg and foot.

Case 7.—I. B., S. M. H. No. 211100: The patient was a 43-year-old tailor, with pain in the back and both legs of seven months duration. Seven months before admission he noticed the onset and progression of pain in the low back and down the backs of both legs, associated with parasthesias, weakness and coldness. These symptoms persisted, and about two months before admission he became unable to void. Subsequently, he catheterized himself regularly. Past history was pertinent in that patient reported an episode of weakness in the legs lasting for a month in 1928, treated by injections of calcium gluconate. No history of trauma was obtained. The patient had lost ten pounds in the previous six months.

Physical Examination.—The following positive findings were apparent: The spine showed a list to the left, with rather marked limitation of motion in all directions and spasm in the paraspinal muscles. There was some diffuse weakness of the anterior and posterior calf muscles but strength in general was quite good. Gluteal tone was very poor. There was anesthesia in the saddle area involving the S-4 and S-5 dermatomes, with a trophic ulcer on the left side in this area. There was complete retention of urine, and the rectal sphincter tone was very poor. Both ankle jerks were absent.

Laboratory Data.—Blood count was normal, and serology was negative. Urinalysis showed pyuria, with *Streptococcus hemolyticus* and *B. proteus* being isolated. Roentgenograms showed a relative narrowing of the lumbosacral interspace. Pantopaque myelography demonstrated a marked narrowing in the visualized column at L-4, and complete block at L-5 (PLATE I, Fig. 7).

At surgical exploration, a large herniated nucleus pulposus, completely compressing the dural sac, was removed from the L-5 S-1 interspace. A pathologic protrusion of the fourth intervertebral disk was also encountered and corrected (PLATE II, Fig. 7).

The postoperative course was one of gradual improvement. Pain had disappeared after about three weeks, and patient first began to void spontaneously about five weeks postoperatively. At this time, cystometry showed normal bladder response. When seen four and one-half months after operation, he still had 90 cc. residual after urination, and some constipation. He reported himself markedly improved but still had mild pain in the back although none was present in the legs. Hypesthesia was still present in sacral areas 3, 4, and 5, and there was mild weakness in plantar flexion on the right. The ankle jerks were absent.

Case 8.—A. B., S. M. H. No. 212371: The patient was a 36-year-old housewife. Four and one-half years before entry, she first noticed the onset of pain in the back associated with cramps and shooting pains in the left leg, increasing in severity. Three years before admission she had a severe episode of backache and pain in both legs, at which time she was studied elsewhere, and was in bed for two months. The pain was worse on coughing and sneezing. Subsequently, she was considerably improved although not completely without pain until about two months before entry, at which time the pain became progressively worse. She noticed that she would drag the right leg, and complained of numbness and tingling in the saddle area. She also noticed increasing urinary urgency and frequency, culminating in complete retention the day before entry. Past history developed that 18 years before admission the patient had her left kidney removed, apparently because of calculi. There were no subsequent urinary complaints until her admitting illness.

Physical Examination.—The following positive findings were present: The patient was confined to bed. There was flabbiness of the glutei and weakness of all movements of the right foot, particularly in plantar flexion. There was no difference in the size of the two legs. Straight leg-raising was limited to 20° on the right and 30° on the left. Saddle anesthesia was present involving S-4 and S-5, as well as the upper portions of the S-3 dermatomes on both sides. Tenderness was present in both gluteal folds. Both ankle jerks were absent. There was an old left flank operative scar.

Laboratory Data: Blood count and urinalysis were normal, and serology was nega-

tive. Complete urologic studies revealed a normal functioning right kidney and an absent left kidney. Roentgenograms of the abdomen showed many calcified nodes on the left side. Cystoscopy showed a small projection of tissue at the vesicle neck (later removed) and some trabeculation of the bladder. Urine culture yielded *B. proteus* and *B. pyocyaneus*. Roentgenograms of the lumbar spine showed a relative narrowing of the fifth lumbar interspace. Spinal fluid protein was 200 mg. per cent, although a few red blood cells were reported present. Pantopaque myelogram shown in Plate I, Fig. 8.

At surgical exploration, a large herniated nucleus pulposus, completely compressing the dural sac, was removed from the lumbosacral interspace. Her postoperative course was uneventful. She began to void spontaneously approximately three weeks after operation. Four weeks after operation, she was ambulatory, without pain. The saddle hypesthesia had definitely diminished and she was able to walk easily. There was still some weakness of the right foot, and the ankle jerks were absent. Nine weeks after operation a letter from the patient reported mild stiffness in the back only, in spite of the fact that she was doing heavy housework. She reported herself otherwise in excellent condition.

DISCUSSION.—Relatively little is known concerning the incidence of extensive herniations of the nucleus pulposus because few cases have been reported. Camp,¹ in 1939, using lipiodol myelography, found that in 194 cases of proved "disks," 11.3 per cent had a partial block and 2.6 per cent complete obstruction of the subarachnoid space. In our experience, of 90 verified cases of herniated nucleus pulposus, there have been eight instances of subarachnoid block, as manifested by myelography, or an incidence of 8.8 per cent.

Other cases are reported in the literature, either singly or as illustrative examples. Dandy,² in 1929, reported two cases of block due to "loose cartilage" in the lumbar region, and described clinical manifestations closely simulating those presented here. Again, in 1942, he³ reported three cases with block: One in the lumbar; one the dorsal; and one the cervical regions. Spurling and Bradford⁴ described two cases, both at the fourth lumbar interspace, and a third case with obstruction due partially to protruded intervertebral disk and partially to arachnoid adhesions. Bunts,^{5, 6} using thorotrast myelography, reported one case with complete block at the fourth lumbar interspace and, using lipiodol, two more cases of block in the region of the third lumbar interspace. Another case is described in the records of the Massachusetts General Hospital⁷ in which a block was encountered at the fourth lumbar interspace.

In our patients, the lesion occurred at the interspace of L-3 in one case; L-4 in four cases; and L-5 in three cases. The age incidence varied between 28 and 62. Three patients were in the third decade, two in the fourth, two in the fifth, one in the sixth, and one in the seventh decades.

The duration of symptoms varied from three weeks to 30 years. In most of the cases, it is interesting to note that there was a long period of prodromal symptomatology culminating in a short, rapidly progressing period of incapacity just before entry into the hospital. In none of these patients was there a history of sufficiently severe single injury to be of associated importance to the patient.

History: The main complaints reported were pain, weakness, sensory disturbances and sphincter disorders. In three of the patients, twitching of the muscle of the legs was reported.

Pain was present in all patients. It was always the symptom of longest duration, usually beginning in the back and subsequently involving the legs. In all but one patient, it involved both legs. Usually, there was a long antecedent history of intermittent back pain for a period varying from seven months to 30 years, and a short period of three days to two months rapidly progressive bilateral leg pain, always of a severe nature.

Weakness of the legs was also a common complaint, being reported as such in five of the patients. It was sometimes difficult for the patient to evaluate weakness because of the pain. All but two patients were confined to bed at the time of hospital admission. In all but one case (Case 7) the weakness was a manifestation of the acute phase usually occurring a few days to a few weeks before admission.

Disturbances of sensation were reported in all cases but one (Case 3), and were, again, manifestations of the acute phase except in two cases (Cases 5 and 7). Usually the disturbance in sensation was described as numbness, but the terms "prickling," "coldness," and "tingling" were commonly used. These disturbances of sensation were reported in one leg in four cases; the saddle area and both legs in two cases; and only the saddle area in one case.

Disturbances of elimination were reported in all cases. This complaint was always a manifestation of the acute phase being present for as long as two months in only two cases. It was nearly always of rapid onset, occasionally being preceded by a few days of increasing difficulty in voiding or increasing constipation. Complete retention of urine was reported in three cases and of urine and feces in one case. Marked difficulty in voiding was present in two cases, and difficulty in voiding plus constipation in two cases.

Physical Examination: In all cases, there was evidence of weakness, atrophy, or poor muscle tone. This was not universally so extensive as might be expected, probably because of the relatively short duration of the acute phase of symptoms. Also, weakness was usually somewhat difficult to evaluate because nearly all of these people were in acute pain at the time of examination and, therefore, often restricted their effort. Atrophy of the glutei, thigh, or calf muscles was reported in four cases, and weakness and poor muscle tone in the same areas in the remaining four cases. The motor impairment was reported to be bilateral in four cases and unilateral in four cases. All but two patients were confined to bed.

Sensory disturbances were present in all cases. These changes varied considerably in extent and location but were universally bilateral. Disturbed sensation in the saddle area was common being present in five cases. This varied from dysesthesia to complete anesthesia, with trophic ulceration in one patient (Case 7). In two patients, sensory disturbances were reported as high as L-1 (Case 2), and D-10 (Case 4). In one of these patients (Case 2),

the lesion was found to be at L-3, and extensive arachnoiditis was encountered on opening the dura. In the remaining patients, sensory changes involved variously L-4 to S-5. Three of the patients with lesions at L-4 had portions of the L-4 dermatome involved. The greatest change, however, involved L-5, or below, in all cases.

The reflexes were altered in all cases. In five cases, the involvement was bilateral and in the remaining three unilateral. Alteration was uniformly present in the ankle jerks and, additionally, in the knee jerk in five cases. There were no cases of a single reflex being altered. In all cases, either both ankle jerks or a knee jerk and ankle jerk were impaired or absent. Those patients with pathology at L-3 and L-4 showed bilateral involvement in three cases and unilateral involvement in two cases. Of these, the knee jerk was impaired in all but one case. When the extrusion was at L-5, the involvement was bilateral in two cases and unilateral in one case, and the knee jerk was impaired in only one case.

Tidal drainage of the bladder was necessary in five patients, both before and after operation. Ability to urinate spontaneously returned in from nine days to five weeks, averaging two weeks. All patients with lesions at L-5 had complete retention while, of those with higher lesions, only two of five showed complete urinary sphincter involvement. The remaining three manifested varying degrees of difficulty in voiding.

Examination of the back was not well recorded in some instances, probably due to the acuteness of the patient's condition on entry. Tenderness was reported in four cases; spasm or limitation of movement in four cases; and no mention was made in one. Similarly, sciatic tenderness or sciatic stretch-tests were not well recorded, probably for the same reasons, although limitation in straight leg-raising was reported in five cases.

Roentgenograms of the back were taken in all cases—in one case elsewhere, but these films were reviewed by a member of the staff and reported to show nothing of significance. In two patients, a list was reported. In five patients, narrowing of an interspace was present, but in one of these (Case 2), the narrowing was not at the site of the proven lesion. Hypertrophic changes were reported in two patients (ages 62 and 56).

Spinal fluid protein determinations were made in six of the eight patients. The levels varied from 60 to 630 mg. per cent. The highest figure represents fluid taken from below the lesion (Case 2), and cisternal fluid on this same patient was 25 mg. per cent. In all other cases, the fluid was taken from above the lesion. In Case 8, a few red blood cells were reported present in the fluid.

Myelography was undertaken in all cases. In one instance this was done by cisternal puncture (Case 2); in the remaining cases by lumbar puncture. In all but one case (Case 2) pantopaque was used. In that one case, lipiodol was used. In all instances, complete, or nearly complete, block was encountered at the site designated. It was felt that this examination was a

good indication of the degree of obstruction because at body temperature, pantopaque has a low viscosity and flows readily. In one instance (Case 7), abnormalities were seen in two interspaces (L-4 and L-5) and at operation, an extruded nucleus pulposus was found at L-5 and a protruded intervertebral disk at L-4. There were no untoward reactions to myelography. The myelograms are shown in PLATE I.

Operative Findings: The early patients were all explored with a preoperative diagnosis of cauda equina tumor. Subsequently, the correct diagnosis was suspected and in the last three was the primary preoperative diagnosis. Recently, however, one patient with a very similar clinical picture was explored with the same preoperative diagnosis but was found to have metastatic carcinoma in the upper sacral segment.

The operative findings were similar in all cases: extruded nuclei pulposi severely compressing the dural sac were encountered and removed. The dura was opened in the first five cases. No mention was made as to the condition of the intrathecal contents other than they were "elevated to a marked degree" in two cases. In the remaining three cases (Cases 1, 2 and 5) thickening of the arachnoid, matting of the cauda equina, and adhesions were prominently present. In two of these cases (Cases 2 and 5) this was present to the extent that obstruction remained after removal of the extruded nucleus pulposus. Spinal fusion was done in three cases (Cases 1, 2 and 3).

Sequelae: All patients were relieved of their pain postoperatively, and were ambulatory and voiding spontaneously on discharge from the hospital. Stay in the hospital after operation varied from 17 to 77 days, the average being 36 days.—The longer hospitalizations were required for the patients who had spinal fusions. The average stay without fusion was 30 days. Two of the patients with fusions convalesced at home.

Follow-up varied from 2 to 16 months. One patient did not return. Three were operated upon within three months, and two of these had a two-month check-up. One patient (Case 1) had fairly extensive residual difficulty eight months after operation. She had weakness of her left foot, requiring use of a cane. There was also some vulvar anesthesia. Two others had a slight limp two months after operation (Cases 6 and 8). The remainder had no complaints when last seen. Two were reported working at their usual occupation, and one was simply reported asymptomatic.

CONCLUSIONS

The clinical similarity between herniated nucleus pulposus and early cauda equina tumors is generally well-recognized. The more advanced manifestations of neoplastic disease are, however, too often considered to be pathognomonic. The patients here reported suggest that herniated nucleus pulposus must be strongly considered even in the presence of advanced cauda equina compression. Herniated nucleus pulposus represents, indeed, in our experience, even a more common cause of such compressive manifestations than tumor. The differentiation between these two entities pre-

operatively is often impossible. The history and examination may present identical findings. All variations, up to complete block, may occur on lumbar puncture in both instances. Only the roentgenologic findings may be of differential aid. A narrowed interspace corresponding to a level of block at myelography should strongly suggest displaced intervertebral disk.

Another factor of possible importance in discogenic disease presented in these patients, is the presence of associated intrathecal inflammatory processes in the form of localized arachnoiditis. It was a very prominent manifestation in three of the five cases in which the dura was opened, and is possibly present to some degree in most of the cases. Some credence to this postulate might be taken from the universally increased spinal fluid protein encountered. A process of this type could possibly offer some explanation to such findings as sensory and motor changes corresponding to a level above the site of herniation as described in many of these patients. Further evidence of its possible importance was encountered in a recent case in which the patient developed rapidly progressing sensory changes, motor weakness, and sphincter involvement two weeks after removal of an uncomplicated displaced intervertebral disk. Repeat myelography demonstrated a complete block at the site of the operative removal instead of the original small defect. Reexploration four weeks after the original operation revealed no extradural pathology, but on opening the dura, an extensive localized arachnoiditis completely agglutinating the caudal filaments together was encountered. The symptoms and findings described disappeared during the next few weeks.

These patients may serve, also, to illustrate a possible danger in delaying operation for displaced intervertebral disk either because of faulty diagnosis or election. Nearly all had evidence of long preexisting discogenic disease yet the diagnosis was not made until all had evidence of extensive cauda equina compression. They were, thereby, subjected to extensively prolonged hospitalization and convalescence, and to the real possibility of crippling neurologic residuum. In view of the fact that many of these patients had minimal complaints prior to the acute episode culminating in cauda equina compression, it seems possible that any patient with discogenic disease might potentially suffer a similar fate. We feel this to be an argument in favor of myelography, certainly in equivocal cases and have used it routinely for two years.

SUMMARY

1. Eight cases of cauda equina compression due to herniated nucleus pulposus are presented. These cases are proven by myelography and operation.
2. This pathologic process was encountered at L-3 in one case; L-4 in four cases; and L-5 in three cases.
3. There is considerable similarity in the symptom complex presented by these patients. Their main complaints were pain in the back and both legs, numbness in the saddle area and/or both legs, weakness, and sphincter

disturbances. In most cases, there is usually a long antecedent history of back pain followed by an acute episode of rapid progression of the above symptoms.

4. The physical findings were also quite similar in all patients. The predominant findings were weakness or atrophy in the gluteal region or both legs, sensory changes in both legs, multiple reflex changes and sphincter abnormalities.

5. Narrowed interspace, determined roentgenologically, was frequently present, and of differential diagnostic importance when found.

6. Increased spinal fluid protein was the rule.

7. Myelography showed complete or nearly complete subarachnoid block in all cases.

8. The presence of marked subarachnoid inflammatory processes was demonstrated, and its possible importance in this condition discussed

9. The difficulty in differentiating this clinical entity from cauda equina tumor preoperatively is apparent.

REFERENCES

- ¹ Camp, J. D., and Addington, E. A.: Intraspinal Lesions Associated with Low Back Pain and Sciatic Pain, and Their Localization by Means of Lipiodol within the Subarachnoid Space. *Radiology*, **33**, 701-711, December, 1939.
- ² Dandy, W. E.: Loose Cartilage from Intervertebral Disk Simulating Tumor of the Spinal Cord. *Arch. Surg.*, **19**, 660-671, October, 1929.
- ³ Dandy, W. E.: Serious Complications of Ruptured Intervertebral Disks. *J. A. M. A.*, **119**, 474-477, June 6, 1942.
- ⁴ Bradford, F. K., and Spurling, R. G.: *The Intervertebral Disk*, Charles C. Thomas, Springfield, Ill., 1941.
- ⁵ Bunts, A. T.: Retropulsion of Ruptured Nucleus Pulposus Simulating Tumor of the Cauda Equina. *Clev. Clin. Quart.*, **7**, 257-260, 1940.
- ⁶ Bunts, A. T.: Surgical Aspects of Ruptured Intervertebral Disk: With Particular Reference to Thorotrast Myelography. *Radiology*, **36**, 605-616, May, 1941.
- ⁷ Case Records of Massachusetts General Hospital. *New England Jour. of Med.*, **228**, 578-580, May 6, 1943.
- ⁸ Cohen, Ira, and Kaplan, Abraham: Tumors in the Region of the Cauda Equina: A Review of 25 Cases. *Am. Jour. Surg.*, **60**, 36-43, April, 1943.